Если сравнивать катализаторы Тип Y и Si/Zr №1,то селективность по светлым, катализатора Si/Zr (№1) выше в 1,05 раз, и температура ниже на 250°С. Сравнивая катализаторы ,например, CaA и Si/Zr (№2),можно отметить, что селективность по светлым для катализатора CaA будет меньше в 1,2 раза, но степень превращения в 1,25 раза будет больше чем у катализатора Si/Zr (№2) при том условии, что температурный режим на 250°С меньше, чем у CaA. Сравнивая катализаторы Тип Y и WO3/Si-Zr, можно отметить, что селективность по светлым, катализатора WO3/Si-Zr будет превышать в 1,07 раза, и степень превращения будет в 4,9 раз больше, и разница температур в 50°С.

Катализаторы WO3/Si-Zr и Si/Zr (№1): селективность по светлым, катализатора Si/Zr №1 будет в 1,01 раза меньше, степень превращения, в 1,2 раза больше при разности температур в 50 °С.

Таким образом, тип катализатора в значительной степени влияет на скорость химических превращений в процессе крекинга и на состав продуктов. Варьируя катализатор (что достаточно легко сделать в условиях аэрозольного нанокатализа ввиду чрезвычайно малых необходимых количеств катализатора), можно изменять состав продуктов, делая будущую промышленную установку крекинга гибкой к изменяющейся конъюнктуре рынка.

CATALYTIC CRACKING OF VACUM GAS OIL USING TECHNOLOGY OF AEROSOL NANOCATALYSIS

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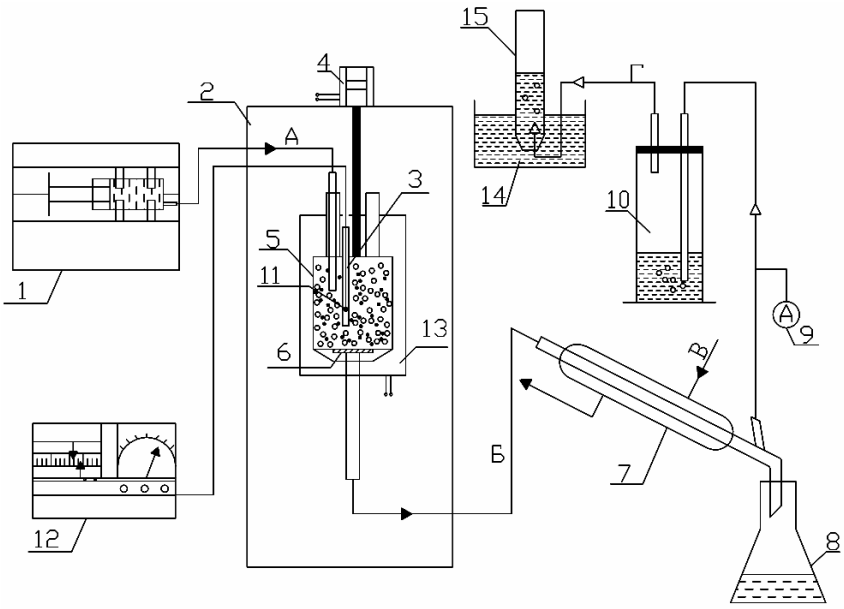
The term “catalysis” was introduced by Berzelius in 1836. Describing various reactions he found that catalysts possess special powers that can influence the affinity of chemical compounds. After many years in 1895 Ostwald proposed the following definition of catalysts: “a catalyst accelerates a chemical reaction without affecting the position of the equilibrium”.

Catalytic cracking is the most common process of secondary processing of crude oil. The main products of this process are gasoline and diesel fractions, and other minor products are gases and coke. In the industry, the process is conducted in a lift-reactor at 723–823 K. In the modern units of catalytic cracking only zeolite containing aluminum-silicate catalysts with rare-earth metals are used.

The refinery industry today plays an important economic and strategic role in the world production of gasoline and light crude oil products. Every year there is an increase in demand for motor fuels and lubricants. Therefore, the industry uses secondary processes such as catalytic cracking, hydrocracking, coking, isomerization, alkylation, reforming and other processes, but also in the existing processes there are ongoing research on how to maximize the potential of refining without expending excess resources and also ways to avoid further endangering of the environment.

The objective of the study of catalytic cracking of vacuum gas oil using aerosol nano catalysis technology is to i) know the favorable conditions as to which high selectivity is achieved, ii) to find out what light product is produced more i.e. (is the SiO_2/ZrO_2 catalyst more selective to gasoline or more selective to diesel and iii) to know if at the lowest temperature $300^{O}C$, if selectivity to light products is still possible regardless of variation in MCA frequency.

The catalytic cracking experimental process of vacuum gas oil was investigated using the laboratory unit shown below in Figure and consist of :(1) - Syringe batcher; (2) - Thermal cabinet; (3) - Pocket of thermocouple; (4) - Vibrating device; (5) - Reactor; (6) - Metal-cloth filter; (7) -Water condenser; (8) - Receiver of liquid fraction; (9) - Sampling point; (10) - Gas washer; (11) - Thermocouple; (12) - Regulator for oscillation frequency and temperature; (13) - Heater; (14) - Water container; (15) - Gas receiver.



The pre-heated vacuum gas oil was fed into the reactor (5) by a syringe-batcher (1), which is located in the thermal cabinet (2), and it was then subjected to thermal treatment by heater (13). Cracking reactions took place inside the reactor. Experiments were conducted at temperatures: 300^{o}C, 350^{o}C, 400^{o}C, 450^{o}C, 500^{o}C, 550^{o}C, and at frequencies between 5.5 – 7 Hz. The temperature in the reaction zone was measured by a thermocouple (11), and sustained by a regulator (12). In order to keep the catalyst inside the reactor, a metal-cloth filter (6) was placed at the bottom of reactor. The liquid reaction products pass through a water-cooled condenser (7) and were then gathered in a flask for the liquid fraction (8). The reaction products were two fractions – liquid and gas. The non-condensed gases from the cracking process go through the sampling point (9), and were then sent to the gas washer (10) where they bubble through the water layer. The gases were then directed into a gas container (15), and passed through container with water (14). The reactor moves upward and downward in a back-and-forth linear motion with the help of vibrating device (4). The oscillation frequency and temperature were set and controlled by a regulator (12). The liquid phase was subjected to fractional distillation so as to separate the resulting mixture into their individual component by using an apparatus ULAB 1–42A The content of the gaseous products of the reaction were analytically determined by using calibrated gas chromatographs such as LHM–8, COLOR–500. Ethylene (C_2H_6) and Hydrogen (H_2) were determined with an accuracy not less than 0.01 vol. %. The products composition and octane number of the gasoline fraction (research and motor methods) were determined by chromatograph CRYSTAL–5000.2.

The results below indicates that the bi metallic catalyst showed a greater affinity towards diesel fractions than gasoline fractions , also , at each MCA frequency, there was selectivity to light products regardless of temperature changes, and also shows that the parameters in which highest selectivity to light products was achieved at frequency of 5.5Hz and temperature of 450^{o}C, and this could be attributed to low temperature, and the fact that the catalyst does not undergo intense thermal softening, and at this frequency the rate at which vibration occurs, is not as vigorous as compared to vibrations that occur at MCA frequency of 7Hz, and also not as mild as MCA frequencies of 4 Hz -5 Hz , it is the perfect frequency. And also it is noted that at high temperatures of 550^{o}C, regardless of change of frequency, selectivity was minimal, and this could be attributed to severe thermal softening of the catalyst which is common in high temperature reactions.

Table 1 results obtained from catalytic cracking using MCA frequency 5.5-7Hz and temperature 300°C-550°C

№	T, (oC)	F, Hz	Yield of cracked products				Octane number		Sum total of light products yield	Volume of gas oil (ml)
			Gas	Volume of gasoline (ml) 80-180oC	Volume of diesel (ml) 180-350oC	Coke (gm.)	Research method	Motor method		
1	2	3	4	5	6	7	8	9	10	11
1	550	5.5	10	13	37	0.084	91.20	68.59	50	100
2	500		2	21	48	0.313	96.37	72.58	69	100
3	450		1	14	64	1.5	93.49	76.12	80	100
4	400		0	13	36	0.0938	86.54	78.32	49	100
5	350		0	12	53	0.077	89.20	67.74	68	100
6	300		0	12	43	0.0588	84.77	66.22	55	100
7	550	6	8.5	11	28	0.0847	93.17	83.07	39	100
8	500		10	10	33	0.0326	89.28	69.12	43	100
9	450		7	11	36	0.0931	90.84	78.22	47	100
10	400		4	9	31	0.130	89.64	75.87	40	100
11	350		0	11	53	0.210	88.68	74.19	64	100
12	300		0	11	48	0.3121	88.32	76.28	59	100
13	550	6.5	14	13	13	0.07971	91.46	69.69	26	100
14	500		13	20	29	0.17304	90.32	73.34	49	100
15	450		1	4	15	0.0455	89.19	69.48	19	100
16	400		1	8	18	0.02132	88.04	69.80	26	100
17	350		0	7	17	0.02754	90.65	74.45	24	100
18	300		0	11	29	0.02068	90.88	78.29	40	100
19	550	7	12	15	10	0.603	94.04	72.21	25	100
20	500		4	9	8	0.1458	91.23	72.81	17	100
21	450		7	11	27	0.0729	88.40	68.25	41	100
22	400		0	14	41	0.1376	87.14	66.89	55	100
23	350		0	12	28	0.2547	88.21	68.56	40	100
24	300	7	0	12	12	0.1023	89.07	72.17	24	100